Instruction Manual

MODEL 2 SURVEY METER

LUDLUM MEASUREMENTS, INC.
501 OAK 915 • 235-5494 P. O. BOX 810
SWEETWATER, TEXAS, U.S.A., 79556

DESIGNER AND MANUFACTURER
OF
Scientific and Industrial
INSTRUMENTS

MP MASTER
MA29140

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 FAX NO. (915) 235-4672
501 OAK STREET TELEX No. 466832 UD
SWEETWATER, TEXAS, U. S. A. PH. 915-235-5494

CUSTOMER AT&T Bell Labs ORDER NO. 89-5855

Mfg. Ludlum Model 2 Serial No. 70876

Mfg. Ludlum Det. Model 44-7 Serial No. PR 063823

Cal. Date 1-9-90 Cal. Due Date 1-9-91 Cal. Interval 1yr METERFACE 325

Check mark (✓) applies to applicable instr. and/or detector IAW mfg. spec, s. ☑ New Instrument

☐ Det. (Alpha) Bkgnd ____ cpm ☑ Det. Oper. V 900 V at 27 MV

T 25 °F RH 50 % Alt 705.8 mm Hg ☑ F/S Resp. ck ☑ Zero Reset ck. ☑ Audio ck. ☑ Meter Zeroed

☑ Bat. ck. (Min. Volt) 2.2 VDC ☐ Bat. Volt ____ VDC Instrument Volt Set 900 V

☐ Threshold Dial ____ Input Sens. 27 mV. ☐ Input Sens Linearity

☐ HV Readout (2 points) Ref./Inst. ____/____V Ref./Inst. ____/____V

☐ Alarm Setting ck. ☐ Window Operation ☐ Background subtract ☑ Mechanical ck.

Repair Instrument Received: ☐ Within Toler. + -10% ☐ 10-20% ☐ Out Toler. ☐ Requiring Repair

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M. 44-9 in which the back of probe faces source.

RANGE MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT METER READING	INSTRUMENT REC'D "AS FOUND READING"
X 10	40 mR/hr	4	
X "	10 "	1.1	
X 1	4 " = 10400 cpm	4	
X "	1 "	1	
X 0.1	1040 cpm	4	
X "	260 "	1	
X			
X			
X			
X			
X			

10.1 Range(s) Calibrated Electronically

	Reference Cal. Point	Instrument Meter Reading	"As Found Reading"
Digital Readout	/ / / / /	/ / / / /	/ / / / /
Log Scale	/ / / / /	/ / / / /	/ / / / /

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Bureau of Standards, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants, or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of MIL- STD-45662A and ANSI N323-1978.

☑ Cs137 Gamma s/n 1162 ☐ Neutron Am-241 Be s/n T-304 State of Texas Calibration License No. LO-1963

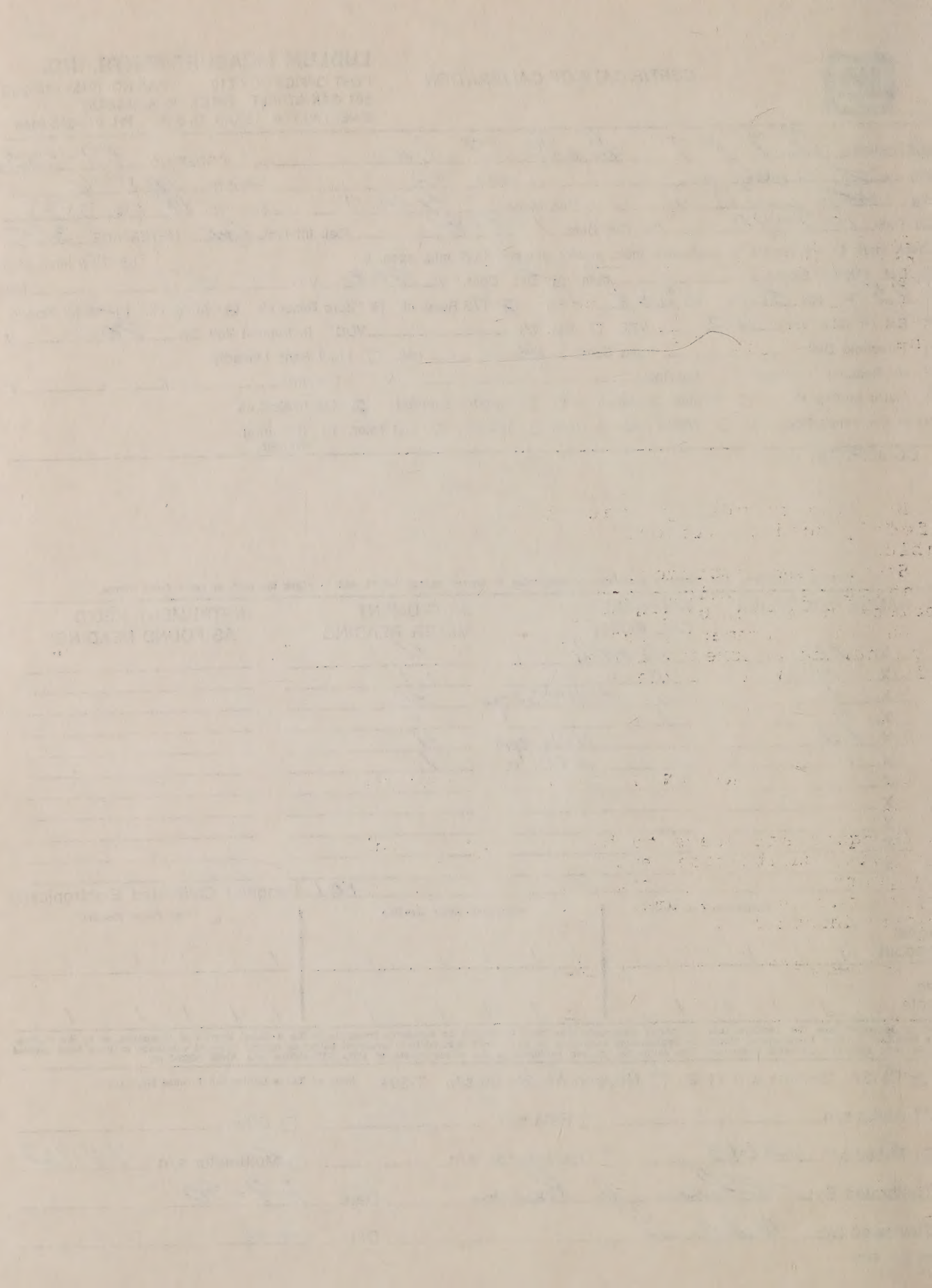
☐ Alpha s/n ____ ☐ Beta s/n ____ ☐ Other ____

☑ M-500 s/n 13663 ☐ Oscilloscope s/n ____ ☑ Multimeter s/n A34153

Calibrated By: Thomas J. Losson Date 1-9-90

Reviewed By: Patrick Baaud Date 1-9-90

Form 22 — 5/89



WARRANTY CERTIFICATE

Ludlum Measurements, Inc. warrants the products covered in this Instruction Manual to be free of defects due to workmanship, materials, and design for a period of twelve months from the date of delivery.

In the event of instrument failure, notify Ludlum Measurements, Inc. for repair or replacement. Liability of this warranty is limited to the purchase price of the instrument.

RECEIVING CONDITION EXAMINATION

Be sure to verify that the shipping carton is received in perfectly good condition. For example, that no damage should be visible.

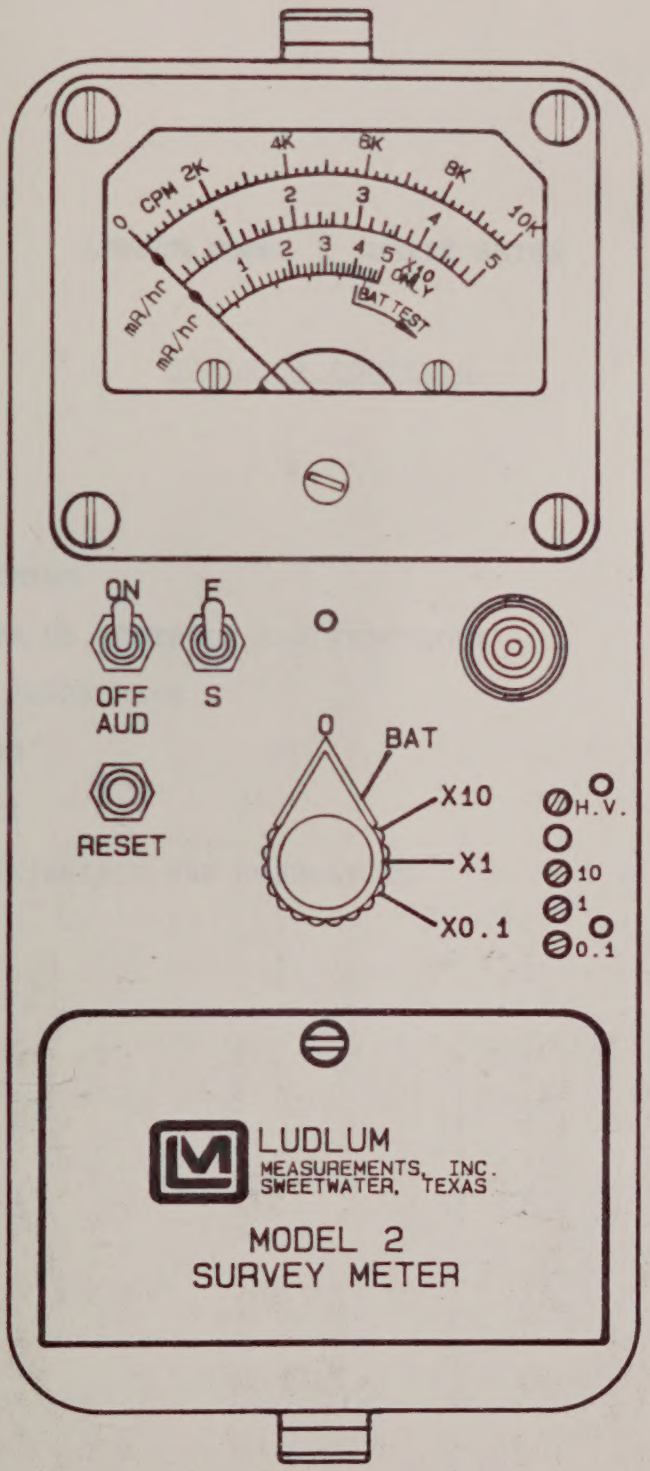
Should the instrument be received in a damaged condition, save the shipping container and the packing material and request an immediate inspection by the carrier.

Ludlum Measurements, Inc. is not responsible for the damage which occurs during shipment, but will make every effort to help obtain restitution from the carrier.

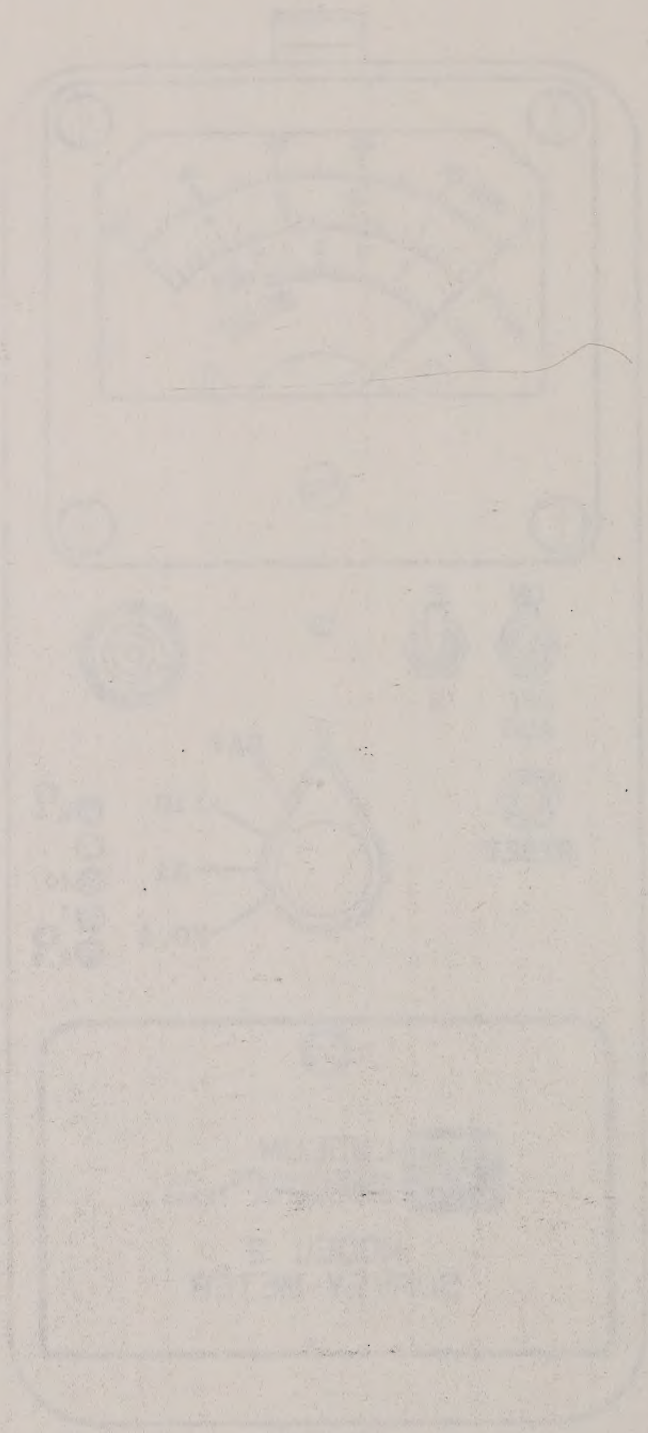
RETURN OF GOODS TO MANUFACTURER

If equipment needs to be returned to Ludlum Measurements, Inc. for repair, calibration, etc., please do so by the appropriate method of shipment. All shipments should include documentation containing shipping address, customer name and telephone number, and all other necessary information.

Your cooperation will expedite the return of your equipment.



CNG	NO.				DRN	CHK	APP
DRN MSM	DATE 8/8/88	CHK	DATE	APP	DATE		
TOL: SHOP STD ☐ OTHER			SCALE: FULL ☐ OTHER				
TITLE MODEL 2 SURVEY METER							
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556			SERIES 363		SHEET 171		



LUDLUM MODEL 2 SURVEY METER

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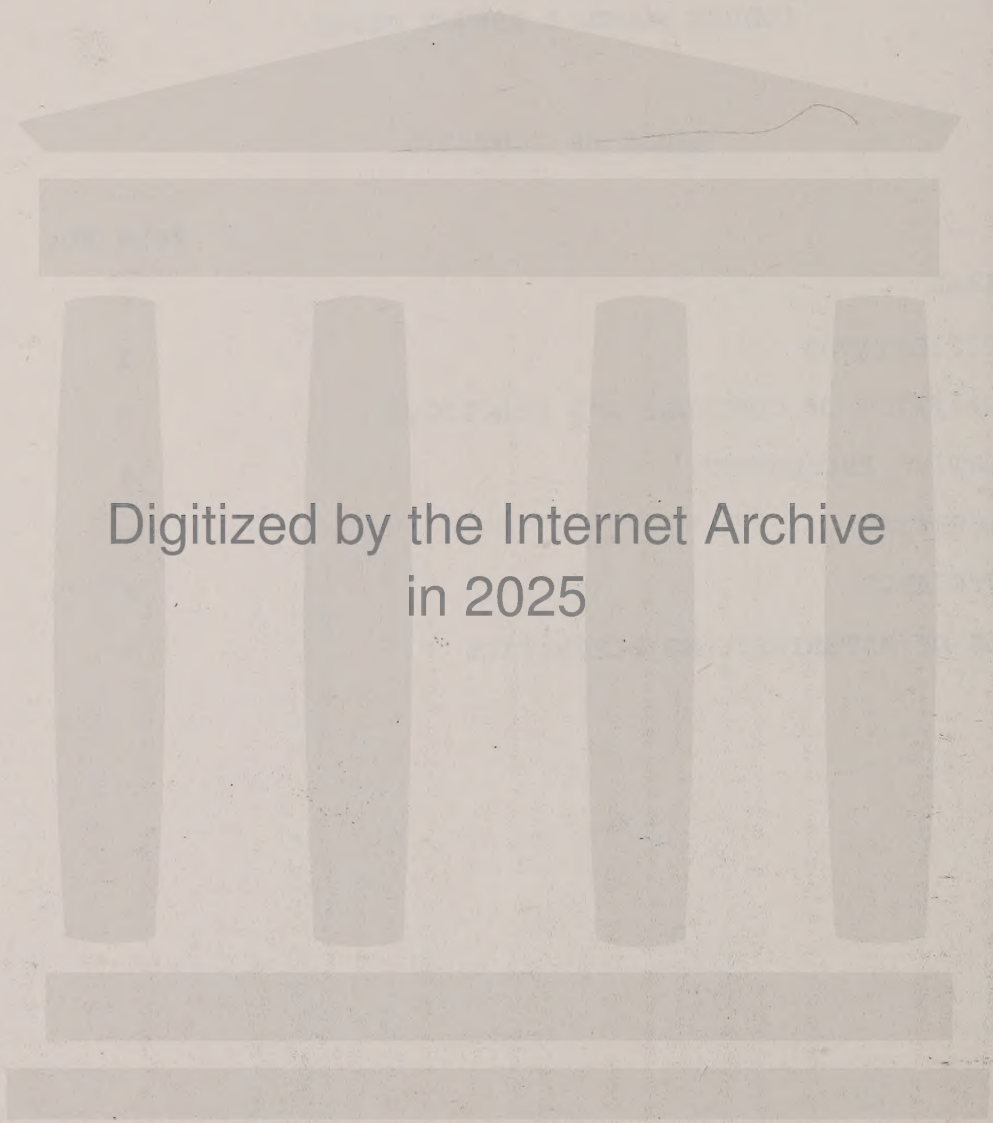

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1. GENERAL

The Model 2 is a portable survey instrument that operates on two standard "D" cell flashlight batteries. The instrument features a regulated high voltage power supply adjustable from 400 to 1500 volts.

The unit body is made of cast-aluminum, including the meter housing. The can is 0.090 aluminum. Other operating features of the instrument include a unimorph speaker mounted to the instrument can with an audio ON-OFF capability, fast-slow meter response, meter reset button and a 5-position switch for selecting battery check or scale multiples of X0.1, X1 and X10. Each range multiplier has its own calibration potentiometer.

Any G-M probe offered by the company will operate on this unit as well as many of the scintillator-type detectors. The instrument is set for 900 volts G-M tube operation. For special requirements, it may be adjusted for operation with any G-M or scintillator tube between 400 and 1500 volts.

The unit is operated with two flashlight batteries for operation from 150° to approximately 32°F. For temperature operation to 0°F, either very fresh alkaline or rechargeable NiCd batteries may be used. Battery drain averages 30 milliamperes.

2. SPECIFICATIONS

POWER: two standard "D" size batteries

THREE LINEAR RANGES: from 0 to 100k Counts/minute, 0-50 mR/hr; meter scale presentation - 0 to 10k CPM & 0-5 mR/hr with multiples of X0.1, X1, X10

SENSITIVITY: 30 millivolts, (±10mV)

AUDIO: built-in unimorph speaker with an ON-OFF switch

HIGH VOLTAGE: externally adjustable from 400 to 1500 volts

RESPONSE: 4 or 22 seconds for 90% of final reading

LINEARITY: plus or minus 5% full scale

CALIBRATION STABILITY: less than 15% variance to battery end point

METER: 1mA, pivot-and-jewel movement, 2 1/2-inch scale

CONNECTOR: Series "C", 706 U/G (BNC or MHV may also be provided).

SIZE: 8.9 (3.5")W X 21.6 (8.5")L X 10.67 (4.2")H exclusive of handle

WEIGHT: 1.36 (3 lbs.) less detector and batteries

3. DESCRIPTION OF CONTROLS AND FUNCTIONS

Range Multiplier Selector Switch is a 5-position switch marked OFF, BAT, X10, X1, X0.1. Turning the range selector switch from OFF to BAT position provides operator a battery check of the instrument. A BAT check scale on the meter provides a visual means of checking the battery status. Moving the range selector switch to one of the range multiplier positions (X0.1, X1, X10) provides the operator with an overall range of 0-50K CPM (0-50 mR/hr if the mR/hr scale is installed). Multiply the scale reading by the multiplier for determining the actual reading.

AUDIO ON-OFF Toggle Switch, in the ON position, operates the unimorph speaker, located on the left side of the instrument. The frequency of the clicks is relative to the rate of the incoming pulses. The higher the rate is, the higher the audio frequency. The audio should be turned OFF when not required to reduce battery drain.

Fast-Slow Toggle Switch provides meter response. Selecting the "F" position of the toggle switch provides 90% of final reading in 4 seconds. In "S" position, 90% of final reading takes 22 seconds. When the instrument is set on "F", there is fast response and large meter deviation. When it is set on "S" position, there is a slow response and damped meter deviation.

RES Button, when depressed, provides a rapid means to drive the meter to zero.

High Voltage Adjustment provides a means to vary the high voltage from 400 to 1500 volts. The high voltage setting may be checked at the connector with an appropriate voltmeter.

Range Calibration Adjustments are recessed potentiometers located underneath the calibration cover on the right side of the front panel. These adjustment controls allow individual calibration for each range multiplier.

4. OPERATING PROCEDURES

NOTE: To open the Battery Lid, twist the lid button counterclockwise 1/4 turn. To close, twist clockwise 1/4 turn.

4.1 Open the lid and install two "D" size batteries. Note (+) (-) marks on the inside of the lid. Match battery polarity to these marks.

NOTE: Center post of flashlight battery is positive.

Close the battery box lid.

4.2 Switch the range switch to BAT. The meter should deflect to the battery check portion of the meter scale. If the meter does not respond, recheck that the batteries have proper polarity.

4.3 Connect the cable to the instrument and detector.

4.4 Turn the instrument range switch to X10. Expose the detector to a check source. The speaker should click with the AUDIO ON-OFF switched to ON.

4.5 Move the range switch to the lower scales until a meter reading is indicated. The toggle switch labeled F-S should have fast response in "F", slow response in "S".

4.6 Depress the RES switch. The meter should zero.

4.7 Proceed to use the instrument.

5. CALIBRATION

5.1 Detector Operating Point: Adjust the high voltage (HV) control for 900 volts at the instrument connector for G-M detectors.

NOTE: Measure High Voltage with a Model 500 pulser or a High Impedance Voltmeter with a high meg probe. If one of these instruments is not available, use a voltmeter with a minimum of 1000 megaohm input resistance.

Turn the instrument to X10. Expose the instrument to a calibrated gamma field and vary the range calibration adjustment control for proper reading.

5.2 Special Use Calibration: For special G-M detector applications, the power supply may be adjusted for 450-volt and 1200-volt G-M tubes. Follow the above procedure, except set the supply at the new operating voltage.

For scintillation counters, connect the scintillator. Expose the unit to a source and develop an operating voltage versus count-rate plot. Set the operating voltage at the flattest portion of this curve; then proceed to adjust each calibration control for the desired meter reading.

5.3 Calibrating CPM Scale: To calibrate CPM scale, a precision pulse generator is required. The pulse generator should be capable of providing a 40-millivolt or greater negative pulse with a rise time of 1 microsecond and a pulse-width of 5 microseconds.

Connect the pulse generator to the instrument and adjust the pulse frequency to provide 4/5-scale deflection on the X10 range (40,000 CPM). Adjust the X10 range calibration potentiometer as required. Decrease the pulse frequency by one decade and move the range multiplier switch to the X1 position. Adjust the X1 range calibration potentiometer as required (4,000 CPM). Decrease the pulse frequency by another decade. Move the range multiplier to X0.1 and adjust the calibration potentiometer as required (400 CPM).

6. MAINTENANCE

NOTE: NEVER STORE THE INSTRUMENT OVER 30 DAYS WITHOUT REMOVING BATTERIES. ALTHOUGH THIS INSTRUMENT WILL OPERATE AT VERY HIGH AMBIENT TEMPERATURES, BATTERY SEAL FAILURE CAN OCCUR AT TEMPERATURES AS LOW AS 100 DEGREES FAHRENHEIT. NEGLECTED BATTERY SEAL FAILURE WILL SURELY CAUSE ONE AWFUL MESS!

Instrument maintenance consists of keeping the instrument clean and periodically checking the batteries and calibration. Once initial calibration is performed, recalibration should not be required if the batteries are maintained in good condition.

An instrument operational check should be performed prior to each use by exposing the detector to a known source and confirming a proper reading on each scale.

Under certain conditions, NRC requires instrument calibration every three months. Check the appropriate regulations to determine a recalibration schedule.

Also at three month intervals, the batteries should be removed and the battery contacts cleaned of any corrosion. If the instrument has been exposed to very dusty or corrosive atmosphere, more frequent battery servicing should be used.

Use a spanner wrench to unscrew the battery contact insulators, exposing the internal contacts and battery springs. Removing the handle will facilitate access to these contacts.

BILL OF MATERIALS

CIRCUIT BOARD, DRAWING 363 X 118

CAPACITORS		Part No.
C1	100pF, 3kV, C	04-5532
C2	.01uF, 100V, C	04-5523
C3	470pF, 100V, C	04-5555
C4	100pF, 100V, C	04-5527
C5	.01uF, 100V, C	04-5523
C6	22uF, 20V, OST	04-5579
C7-C8	100uF, 15V, DT	04-5583
C9	4.7uF, 10V, OST	04-5578
C10	.1uF,100V, C	04-5521
C11	4.7uF, 10V, OST	04-5578
C12	2.2uF, 25V, DT	04-5559
C13	.01uF, 100V, C	04-5523
C14	100uF, 15V, DT	04-5583
C15	100uF, 10V, OST	04-5576
C16	1uF, 35V, OST	04-5575
C17	.1uF, 100V, C	04-5521
C18	100uF, 3kV, C	04-5532
C19	.0027uF, 3kV, C	04-5520
C20-C23	.001uF, 100V, C	04-5518
C24	.01uF, 100V, C	04-5523

TRANSISTORS		
Q4	MPS6534	05-5763
Q5-Q6	2N3904	05-5755
Q7	MPS6534	05-5763

INTEGRATED CIRCUITS		
U1	CA3096	06-6023
U2	CD4093	06-6030
U3	CD4098	06-6066
U4	CA3096	06-6023
U5-U6	LM358	06-6024

LUDLUM MODEL 2 SURVEY METER

DIODES

CR1	1N34A	07-6253
CR2-CR5	1N4007	07-6274
CR6-CR10	1N4148	07-6272
CR11	LM385 Z-1.2	05-5808

RESISTORS

R1	22k	10-7070
R2	2.7M	10-7029
R3	10k	10-7016
R4	470k	10-7026
R5	1M	10-7028
R6	12k	10-7048
R7	1M	10-7028
R8	1M	10-7028
R9	3.3k	10-7013
R10	560k	10-7027
R11	100k	10-7023
R12	75k	10-7074
R13	1M	10-7028
R14	2.7M	10-7029
R15	82k	10-7022
R17	33k	10-7019
R20	270 OHM	10-7007
R21	8.2k	10-7023
R22	82k	10-7022
R23	100k	10-7023
R28	SAT (TYP. 715k 1%)	
R29	330 OHM	10-7053
R31	75k	10-7074
R32	10k	10-7016
R33	4.7k	10-7014
R34	100k 1%	12-7557
R35	16.5k 1%	12-7541
R36	10k	10-7016
R37	1k	10-7009
R38	200 OHM	10-7006
R39	10M	10-7031
R40	1M	10-7028
R41	SAT (TYP. 2.2k)	10-7012
R43	1G	12-7686

LUDLUM MODEL 2 SURVEY METER

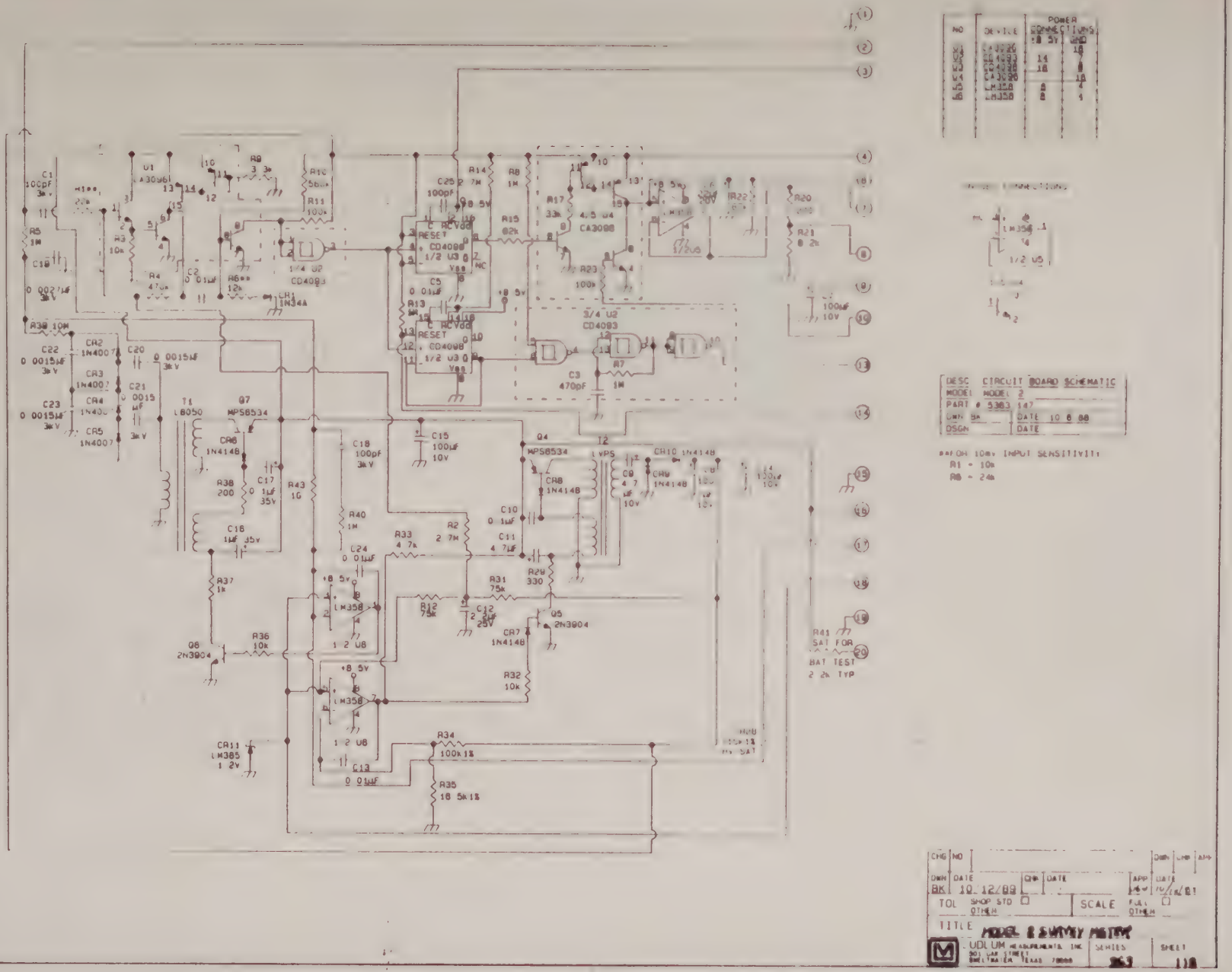
TRANSFORMERS

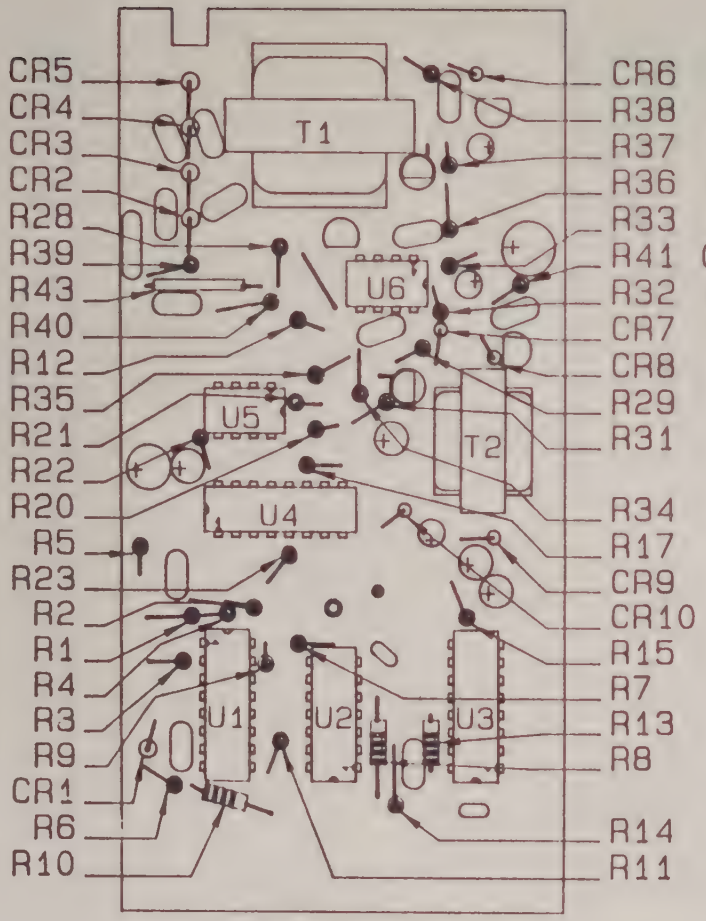
T1	L8050	40-0902
T2	LVPS	40-0944

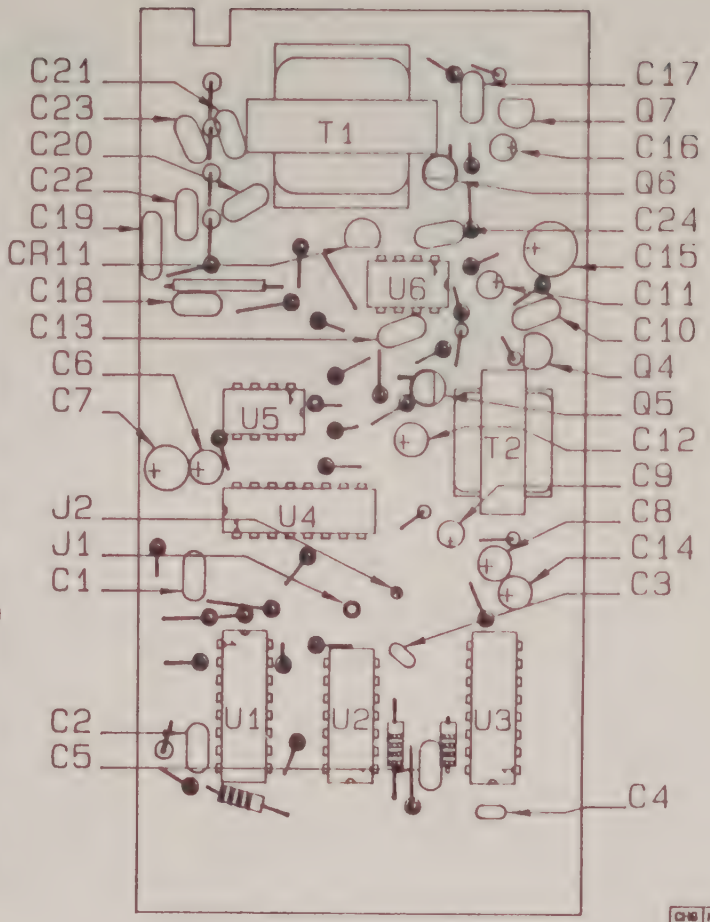
MISCELLANEOUS

7 EACH	CLOVERLEAF RECEPTACLES 011-6809	18-8771
1 EACH (J2)	WALDON 16-06-0007 SMALL RECEPTACLE	18-8792
1 EACH (J1)	WALDON 16-06-0004 LARGE PIN	18-8795

ASSEMBLED CIRCUIT BOARD 5363-147


POWER CONNECTIONS
+8.5V
GND
LM358
1/2 U5
DESC CIRCUIT BOARD SCHEMATIC
MODEL MODEL 2
PART # 9303 147
DWN DATE 10 6 88
DSGN DATE
BAT ON 10mv INPUT SENSITIVITY
R1 = 10k
R8 = 24k
CHG NO
DWN DATE
APP DATE
SCALE
TOL SHOP STD
TITLE MODEL 2 SUPPLY METER
UDLUM MEASUREMENTS INC
SERIES 963
SHEET 1/8





DESC: MODEL 2 CIRCUIT BOARD
BOARD #: 5363-147
DWN: BK | DATE: 10-6-88
DSGN: | DATE:

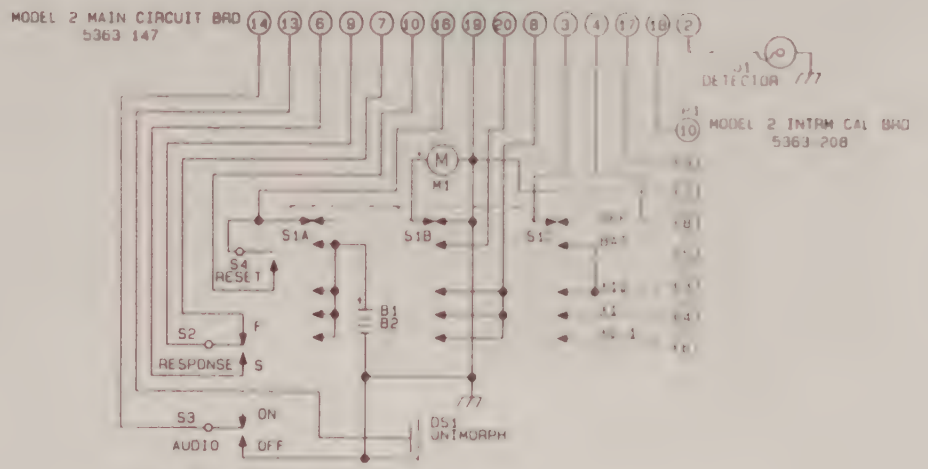
CHG	NO.		DWN	CHK	APP
DWN BK	DATE 10-8-88	CHK DATE	APP	DATE	
TOL: SHOP STD ☐ OTHER		SCALE: FULL ☐ OTHER			
TITLE MODEL 2 SURVEY METER					
LUDLUM MEASUREMENTS, INC. P.O. BOX 810 SWEETWATER, TEXAS 79556		SERIES 363		SHEET 130	

LUDLUM MODEL 2 SURVEY METER

BILL OF MATERIALS

CHASSIS WIRING DIAGRAM, DRAWING NO. 363 X 219

		PART NO.
AUDIO		
DS1	UNIMORPH 60690	21-9251
CONNECTOR		
P1	RIBBON-050-010-455 10P	13-8064
J1	RECPT-UG706/U SCREW-IN C	13-7751
SWITCHES		
S1	CENTRALAB PA600-210	08-6501
S2	RESPONSE F/S MST 105-D	08-6511
S3	AUDIO ON-OFF MST 105-D	08-6511
S4	RESET 30-1 P/B	08-6517
BATTERY		
BT1-BT2	"D" DURACELL BATTERY	21-9313
MISCELLANEOUS		
*	MODEL 2 BATTERY BOX LID	9363-206
*	MODEL 295 BATTERY CONTACT SET	40-1707
*	MODEL 2 CASTING	9363-205
*	MODEL 3/2 MAIN HARNESS	8176-020-00
*	MODEL 3/2 RIBBON HARNESS	8363-020
*	PORTABLE CAN ASSY	4363-189
*	PORTABLE KNOB	08-6613
*	PORTABLE BEZEL FRONT ASSY	4363-188



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MODEL: 2	
PART #: 363-283	
DWN: BK	DATE: 10/11/89
DSGN: DL	DATE: 6/87

CHG	NO			DWN	CHK	APP
DWN	DATE	CHK	DATE	APP	DATE	
BK	10.11.89				10/14/89	
TOL	SHOP STD OTHER		SCALE	FULL OTHER		

TITLE: MODEL 2 SAFETY METER

UDLUM MEASUREMENTS INC
SWEETWATER, TEXAS

SERIES: 363

SHEET: 819

LUDLUM MODEL 2 SURVEY METER

BILL OF MATERIALS

CALIBRATION BOARD, DRAWING NO. 363 X 212

CAPACITORS

C1	.0047uF 100V C X7R	04-5565
C2	.047uF 100V C X7R	04-5570

RESISTORS

R1-R3	1 MEG TRIMMER	09-6814
R5	100K TRIMMER	09-6813

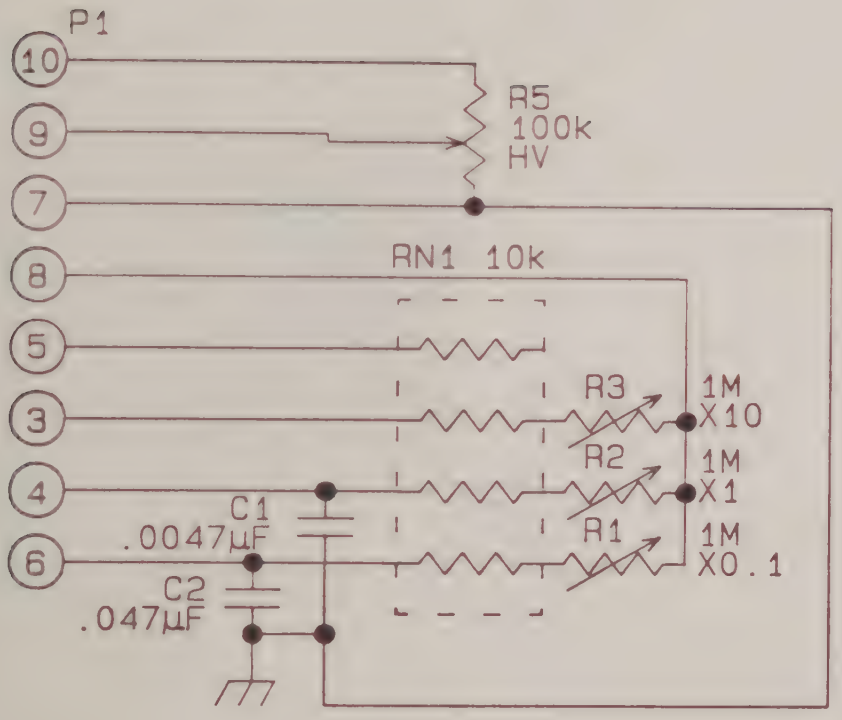
RESISTOR NETWORK

RN1	NETWORK-10K SIP 8PIN	12-7720

MISCELLANEOUS

P1	STRIP-102888-5 10PIN M	13-8110

ASSEMBLED CALIBRATION BOARD 5363-208



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MODEL: 2	
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DSGN: DL	DATE: 6/87

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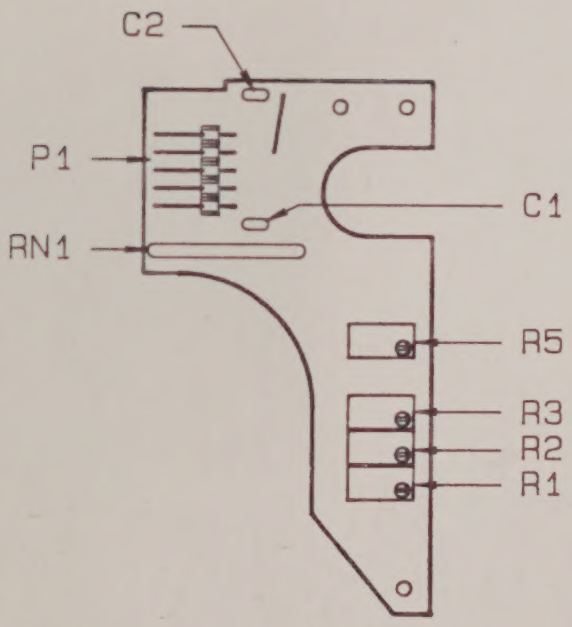
DSGN	DATE	CHK	DATE		APP	DATE	
CKB	10/8/89						
TOL: SHOP STD ☐ OTHER				SCALE: FULL ☒ OTHER			
TITLE MODEL 2 CAL BOARD							
LUDLUM MEASUREMENTS, INC. SWEETWATER, TEXAS 79556				SERIES 363		SHEET 212	



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MODEL: 2	
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DWN: CKB	DATE: 10/6/89
DSGN:	DATE:

CNG	NO.			DWN	CHK	APP
DWN CKB	DATE 10/6/89	CHK	DATE	APP	DATE	
TOL: SHOP STD ☐ OTHER			SCALE: FULL ☒ OTHER			
TITLE MODEL 2 CAL BOARD						
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556			SERIES 383		SHEET 213	

MP MASTER
MA29140